Analyze Trace Amounts of Solvents in Water Using Packed Column GC

Glass or stainless steel columns containing 80/120 Carbopack B/3% SP-1500 packing can be used to analyze water-based samples for ppm to low percentage levels of many organic compounds. This bulletin describes minimum detection limits and maximum capacity of these columns, adsorption and memory effects, and other factors that affect component quantitation. Problems are defined that might arise during trace analyses of compounds in aqueous samples, and recommendations are made for solving these problems.

Key Words:
● solvents ● water ● packed column GC

Chromatographers generally express concern about analyzing aqueous samples for trace levels of solvents or other organic compounds, and with good reason. The water in such samples can reduce the life of most GC columns or coelute with sample peaks and interfere with the analysis. On the other hand, glass or stainless steel columns◆ containing 80/120 Carbopack™ B/3% SP™-1500, when used for these analyses, offer excellent separations, stability, and long column life. For example, 10ppm concentrations of alcohols and ketones in water can be analyzed with excellent peak shape and response (Figure A). Table 1 shows retention times for many other compounds on this packing.

Limits for Sample Components

The range over which a solvent can be detected on 80/120 Carbopack B/3% SP-1500 is 0.9ng to 65µg. Using a pentane solution and a flame ionization detector (FID), we determined the sample capacity of the packing. This was done graphically by plotting the quantity of pentane injected versus peak symmetry at 10% of peak height, and noting where peak asymmetry exceeded an acceptable level (Figure B). A peak with an asymmetry value between 0.9 and 1.1 was considered symmetrical.

In determining the lower limit for detecting solvents in water by using Carbopack B/3% SP-1500 (again using an FID), we established calibration curves for glass and stainless steel columns. Peak areas were determined for various concentrations of isopropyl and sec-butyl alcohol, acetone, and methyl ethyl ketone (MEK). Peaks for each solvent were symmetrical, even at trace levels. To evaluate the linearity of peak response, we plotted the peak area versus solvent concentration data and made a least squares determination for the best line to fit the data. The correlation coefficient,

◆Throughout this study, Supelco™ TightSpec glass and Supelco premium grade stainless steel were used as the column tubing materials.

Figure A. 10ppm Solvents in Water

Packing: **80/120 Carbopack B/3% SP-1500**
Cat. No.: **11813** (packing)
Column: 2m x 2mm ID TightSpec™ glass
Oven: 100°C
Carrier: nitrogen, 20mL/min
Det.: FID, 250°C
Inj.: 1µL water containing 10ppm each solvent, 200°C

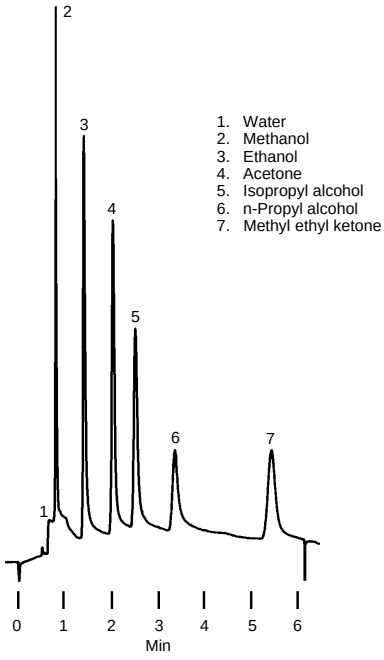

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Figure B. Sample Capacity of 80/120 Carbopack B/3% SP-1500 Packing

µg Pentane	Peak Symmetry
15.6	1.1
20.8	1.1
26.0	1.1
36.4	1.1
41.6	1.0
52.0	0.96
78.0	0.83

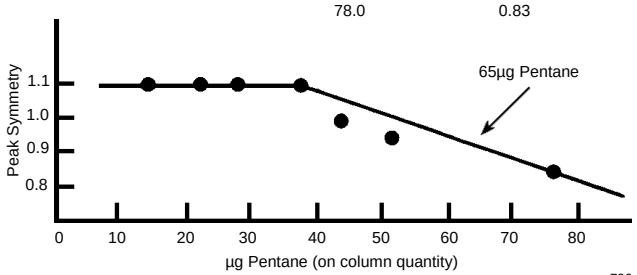

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Table 1. Retention Times for Organic Compounds on 80/120 Carbopack B/3% SP-1500 Packing

Industrial Compounds	t_R (min)
Methane	1.06
Ethylene	1.33
Acetylene	1.40
Ethane	1.54
Methanol	2.39
Propylene	2.68
Propyne	2.78
Acetaldehyde	2.78
Propane	2.91
Methyl formate	3.80
Acetonitrile	4.55
Ethanol	4.60
Isobutane	5.70
Propionaldehyde	6.37
Acetone	6.73
Acrylonitrile	7.54
n-Butane	7.06
Methylene chloride	7.08
Isopropyl alcohol	7.97
Ethyl formate	8.71
Methyl acetate	8.71
Carbon disulfide	9.43
n-Propyl alcohol	9.84
Isobutyraldehyde	11.50
Ethyl ether	11.53
Ethyl vinyl ether	11.53
tert-Butyl alcohol	12.02
THF	12.90
Chloroform	13.34
n-Butyraldehyde	13.38
MEK	13.50
Freon® TF	14.11
Pentane	14.68
Methyl Cellosolve®	14.69
Vinyl acetate	14.94
sec-Butyl alcohol	15.09
Ethyl acetate	15.54
2-Nitropropane	18.00
n-Butyl alcohol	18.36
Crotonaldehyde	18.36
2-Methyl pentane	19.19
Ethyl Cellosolve	19.78
Benzene	20.16
Isovaleraldehyde	20.22
3-Methylpentane	21.07
3-Methyl-2-butanol	21.88
DMF	21.99
n-Valeraldehyde	22.32
Hexane	22.69
3-Pentanol	23.22
n-Propyl acetate	23.75
Ethyl acrylate	23.92
Methyl methacrylate	24.48
Isopentanol	24.81
1-Pinanol	26.42
Ethyl isopropyl ketone	26.96
sec-Butyl acetate	28.40
2-Methyl pentanol	28.49
Dimethyl acetamide	29.03
Cyclohexanone	29.40
2-Methyl-3-pentanol	29.66
Isobutyl acetate	30.00
Propyl propionate	31.33
Ethyl methacrylate	31.39
Isohexanol	31.71
n-Butyl acetate	31.90
Toluene	31.90
Mesityl oxide	31.90
Heptane	31.94
1-Hexanol	33.98
Cellosolve acetate	36.10
Butyl Cellosolve	36.80
Isoamyl acetate	37.60
Ethylbenzene	38.40
n-Butyl acrylate	39.20
Isoheptanol	39.60
Octane	39.98
1-Heptanol	41.44
m-Xylene	41.50
p-Xylene	42.50
o-Xylene	43.40
Nonane	52.20
Decane	76.75

C1-C5 Hydrocarbons	t_R (min)
Methane	1.21
Ethylene	1.61
Ethane	1.86
Propylene	3.7
Propane	4.1
Isobutane	8.7
Butene-1	9.3
Isobutylene	9.7
Butadiene-1,3	10.6
n-Butane/cis-Butene-2	10.9
trans-Butene-2	11.6
Isopentane	18.6
Pentene-1	18.9
n-Pentane	21.0

Hazardous Solvents	t_R (min)
Chloroform	14.6
Pentane	15.2
1,1,1-Trichloroethane	18.3
1,4-Dioxane	18.6
Carbon tetrachloride	19.9
Isopropyl acetate	21.4
Benzene	21.8
Hexane	23.9
1,1,2-Trichloroethane	24.4
Methyl isobutyl ketone (MIBK)	28.3
Methyl isoamyl ketone (MIAK)	36.4

Volatile Wastewater Pollutants	t_R (min)
Methanol/Water	2.8
Methylene chloride	7.9
1,1-Dichloroethylene	10.5
Bromochloromethane	12.2
trans-1,2-Dichloroethylene	13.1
1,1-Dichloroethane	13.1
Chloroform	15.0
1,2-Dichloroethane	16.0
Carbon tetrachloride	20.4
Bromodichloropropane	20.4
1,2-Dichloropropane	22.4
Benzene	22.4
trans-1,3-Dichloropropene	22.4
Chlorodibromomethane	22.4
cis-1,3-Dichloropropene	24.3
Trichloroethylene	25.7
1-Chloro-2-bromopropane	27.5
Bromoform	31.2
1,1,2,2-Tetrachloroethylene	33.0
Toluene	33.0
1,4-Dichlorobutane	34.4
1,1,2,2-Tetrachloroethane	34.4
Chlorobenzene	36.2
Ethylbenzene	39.4

Packing: **80/120 Carbopack B/3% SP-1500***
Cat. No.: **11813** (packing)
Column: 10' x 1/8" OD stainless steel*
Oven: 70° to 235°C at 4°C/min (industrial compounds, hazardous solvents, volatile pollutants) or 40° to 235°C at 4°C/min (C1-C5 hydrocarbons) and hold
Carrier: nitrogen, 24cc/min (industrial compounds, C1-C5 hydrocarbons) or 20mL/min (hazardous solvents, volatile pollutants)
Det.: FID

*Pre-packed columns for many instruments are available (see Ordering Information).

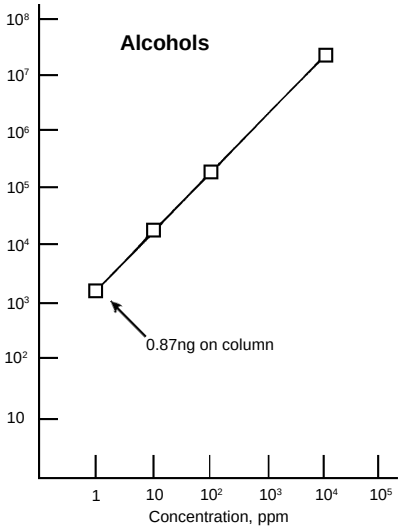
0.999, indicates the data points fall on a straight line. Thus, the detector response was linear for both alcohols and ketones, even at extremely low solvent concentrations. The relative standard deviation (RSD) for the area count at each concentration ranged from 1 to 4%. This low RSD at each level indicated there was no component carry-over or "memory" from one injection to another.

The detector response was almost identical for alcohols and ketones analyzed on glass and stainless steel columns (Figure C). This, however, does not mean that all glass and stainless steel tubing will provide equally good results. Only chromatography grade stainless steel or deactivated glass tubing should be used for analyzing trace components in aqueous samples.

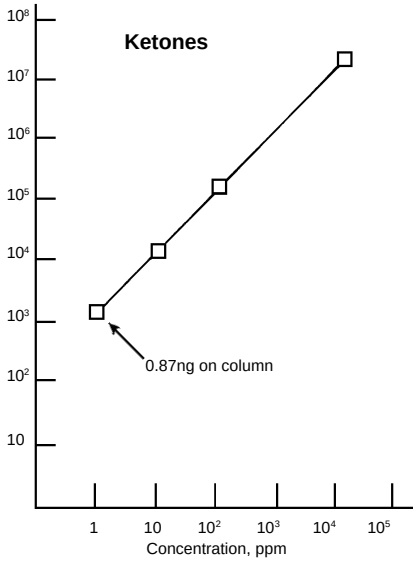
The limiting factor in analyzing trace levels of alcohols and ketones in water proved to be the sensitivity limit of the FID. In these experiments we operated the chromatographic system at 2×10^{-12} AFS, close to maximum sensitivity. According to Gill and Hartmann (1), the minimum detectable peak height for an FID is 2×10^{-14} amperes, or twice the signal to baseline noise level. Using data obtained for ketones at the 1ppm level (Figure D) and extrapolating by Gill and Hartmann's procedure, we calculated that we were detecting peaks representing 2.4×10^{-14} amperes. Therefore, further dilution would have put the ketone concentration below the minimum detection limit of the FID. With more sensitive detection systems, samples containing less than 1ppm (0.0001% vol/vol) might be analyzed successfully.

Figure C. Linear Response for Alcohols and Ketones on 80/120 Carbopack B/3% SP-1500

Packing: **80/120 Carbopack B/3% SP-1500**
Cat. No.: **11813** (packing)
Column: 2m x 2mm ID TightSpec glass and 10' x 1/8" OD stainless steel
Oven: 100°C
Carrier: nitrogen, 20mL/min
Det.: FID, 250°C
Inj.: 200°C



Data points for sec-butyl alcohol and isopropanol on glass and stainless steel columns are within each square.



Data points for acetone and methyl ethyl ketone on glass and stainless steel columns are within each square.

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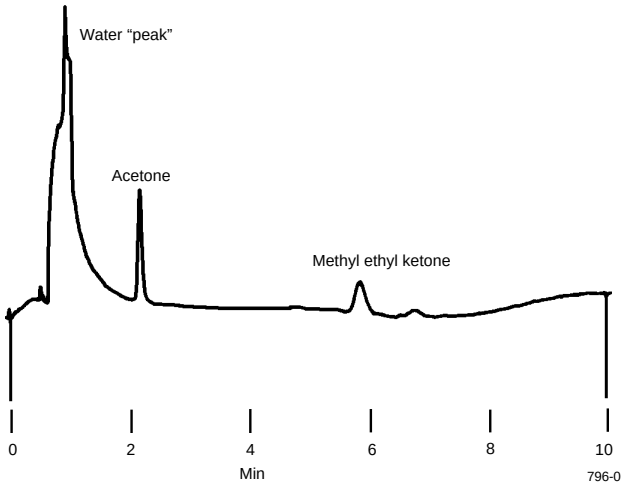
Figure D. Trace Levels of Ketones in Water, Analyzed Without Extraction

Packing: **80/120 Carbopack B/3% SP-1500**
Cat. No.: **11813** (packing)
Column: 2m x 2mm ID TightSpec glass
Oven: 100°C
Carrier: nitrogen, 20mL/min
Det.: FID, 250°C
Inj.: 1µL water containing 1ppm (0.0001%) each ketone (0.87ng), 200°C



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Effects of Water on Packing Stability

Repeated injections of aqueous solutions do not harm Carbopack B/3% SP-1500 packing. Column efficiency, column polarity, and peak retention times (chromatographic parameters that are sensitive to changes in column characteristics) were unchanged after rigorous column testing. To determine the effects of prolonged exposure to water on Carbopack B/3% SP-1500 packing, we injected over 200 aliquots of an aqueous solution of six solvents (approximately 10ppm each) onto a glass column and a stainless steel column, each filled with the packing. We monitored column efficiency, column polarity, and solvent retention times, and compared data from the first four injections to data from the last four injections (Table 2).

If water were to damage the packing, **column efficiency** would decrease. No such decrease was observed. In fact, column efficiency increased slightly during the investigation (Table 2).

The relative retention times of compounds depend on the specific chemical properties of the stationary phase **(column polarity)**. A shift in relative retention times, therefore, would indicate a chemical change in the packing. Relative retention times were monitored for two solvents, isopropyl alcohol and MEK. Since these were unchanged after 200 injections (Table 2), column polarity was unaffected by water.

If water were to strip the phase from the Carbopack column, or otherwise affect the column stability, **absolute retention times** would shift. The data in Table 2 indicate insignificant shifting of retention times (i.e., from 12.87 to 12.97 minutes, a shift of only six seconds) after 200 injections. Shifts of this magnitude often occur from day to day, or even between sequential injections.

Effects of Water on Solvent Quantification

In analyses of aqueous samples on Carbopack B/3% SP-1500, the "peak" attributed to water appears early on the chromatogram. If a thermal conductivity detector (TCD) is used, the water peak is large and will mask peaks for some low molecular weight compounds. For example, when a TCD and a 10' x 1/8" stainless steel column packed with Carbopack B/3% SP-1500 are used, the water peak interferes with the methanol peak (Figure E1). This interference can be minimized (eliminated in some cases) by using an FID. The FID selectively detects the low molecular weight hydrocarbons while responding minimally to water. When an FID and the same 10' stainless steel column are used, methanol can be quantified (Figure E2). Water does not interfere with components eluting after methanol, whether an FID or a TCD is used.

To confirm that Carbopack B/3% SP-1500 columns do not produce memory peaks (**ghosting**), we analyzed aqueous samples

Table 2. Effects of 200 Aqueous Samples on Carbopack B/3% SP-1500 Columns

	Mean for Initial 4 injections	Mean for Last 4 Injections	Ratio of Change (Final:Initial)
Glass Column (2m x 2mm ID)			
Column Efficiency (plates/meter)	2173 ± 109	2209 ± 66	1.02
Column Polarity (Relative retention time of MEK:isopropanol)	1.60 ± 0.00	1.61 ± 0.00	1.01
Total Analysis Time (minutes)	5.47 ± 0.01	5.49 ± 0.01	1.00
Stainless Steel Column (10' x 1/8" OD)			
Column Efficiency (plates/meter)	2043 ± 102	2136 ± 192	1.05
Column Polarity (relative retention time of MEK:isopropanol)	1.67 ± 0.00	1.65 ± 0.00	0.99
Total Analysis Time (minutes)	12.87 ± 0.01	12.97 ± 0.4	1.01

Figure E. Effect of the Detector on Analyses of Solvents in Aqueous Samples

Packing: **80/120 Carbopack B/3% SP-1500**
Cat. No.: **11813** (packing)
Column: 10' x 1/8" OD stainless steel
Oven: 100°C
Carrier: nitrogen, 20mL/min
Det.: E1 — TCD, 250°C
E2 — FID, 250°C
Inj.: 1µL water containing 1% each component, 200°C

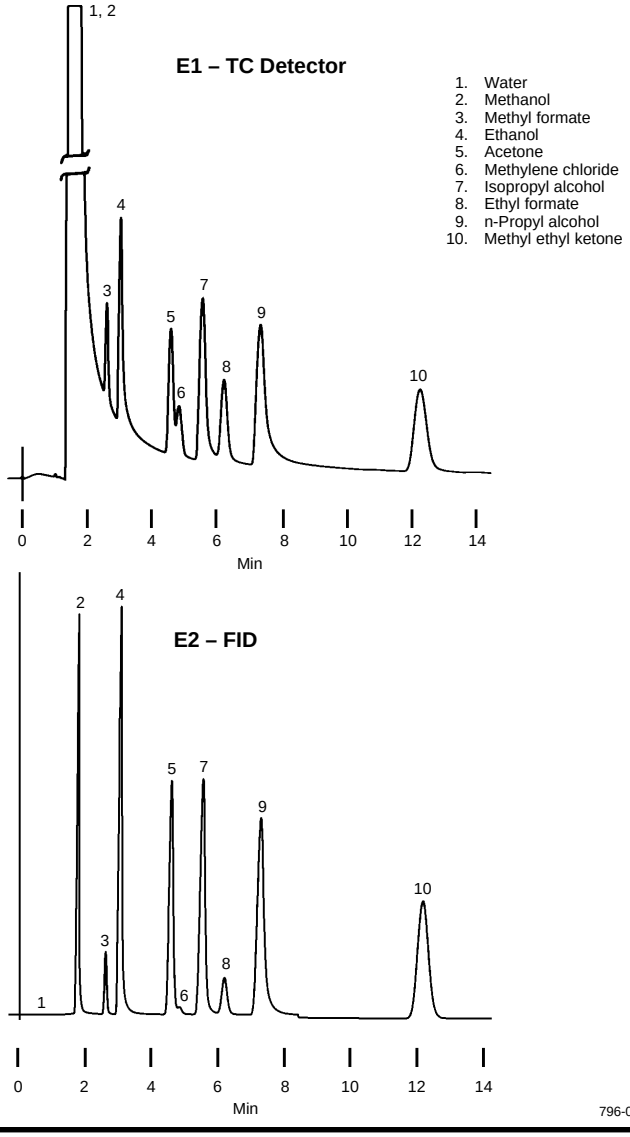

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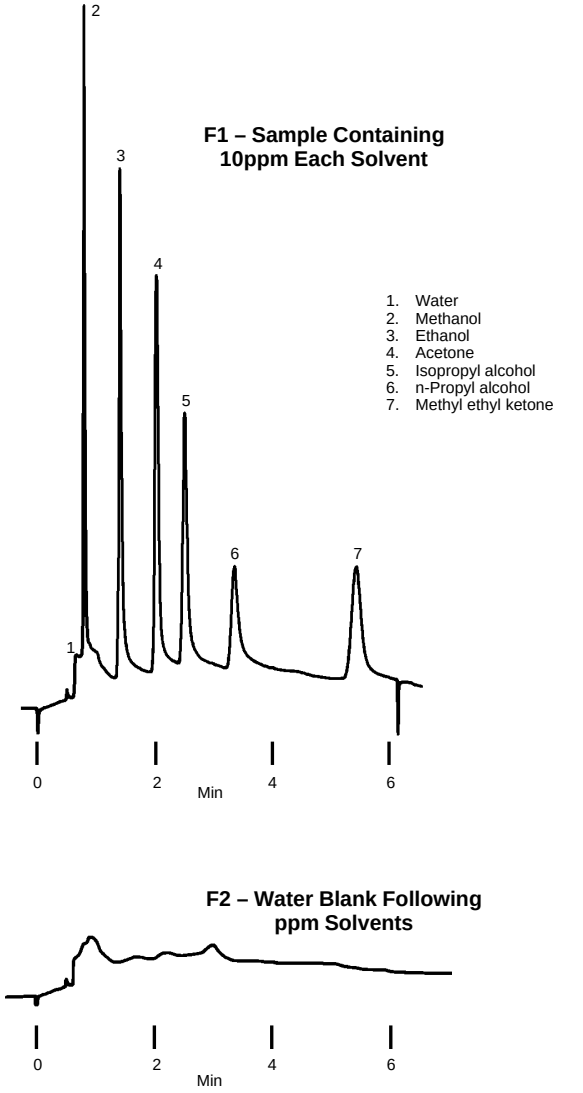
Figure F. No Ghosting with ppm Concentrations of Solvents

Packing: **80/120 Carbopack B/3% SP-1500**
Cat. No.: **11813** (packing)
Column: 2m x 2mm ID TightSpec glass
Oven: 100°C
Carrier: nitrogen, 20mL/min
Det.: FID, 250°C
Inj.: F1 — 1µL water containing 10ppm each solvent, 200°C
F2 — 1µL deionized water, 200°C



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containing high (1%) and low (10ppm) concentrations of solvents, following these with injections of pure water. Under conditions appropriate to each analysis, no memory peaks were observed during the analyses of pure water that followed either the 1% or 10ppm (Figure F) levels of solvents. A column used to analyze percent levels of compounds subsequently can be used to analyze ppm levels of compounds. However, much greater detection sensitivity is required. Consequently, the analyst should observe the precautions explained in the next section.

Precautions for Analyzing Trace Levels of Organic Compounds

Certain precautions must be observed prior to and during analyses of sample components at trace levels. Particular care should be taken with column conditioning, use of glass wool plugs, sample size, sources of sample contamination, and detector sensitivity.

Proper **column conditioning** ensures a stable baseline at high detector sensitivities needed in trace analyses. A new column should be programmed from ambient temperature to the upper limit of the stationary phase to bleed off volatile components of the phase. Follow the conditioning instructions that accompany Carbopack B/3% SP-1500 columns and packing.

After this initial conditioning, inject a series of pure water samples onto the column to remove any remaining contaminants and to reduce the size of the water "peak." Figure G demonstrates the effect of water conditioning. During the first injection onto a new Carbopack B 3%/SP-1500 column, water interferes with the methanol peak (Figure G1). By the fifteenth injection this interference decreases significantly, allowing better quantitation of methanol (Figure G2). To immediately obtain quality chromatograms from a new column, condition the column with water (under the conditions you intend to use) until the water peak is acceptable. If the column is used infrequently, repeat this water conditioning accordingly.

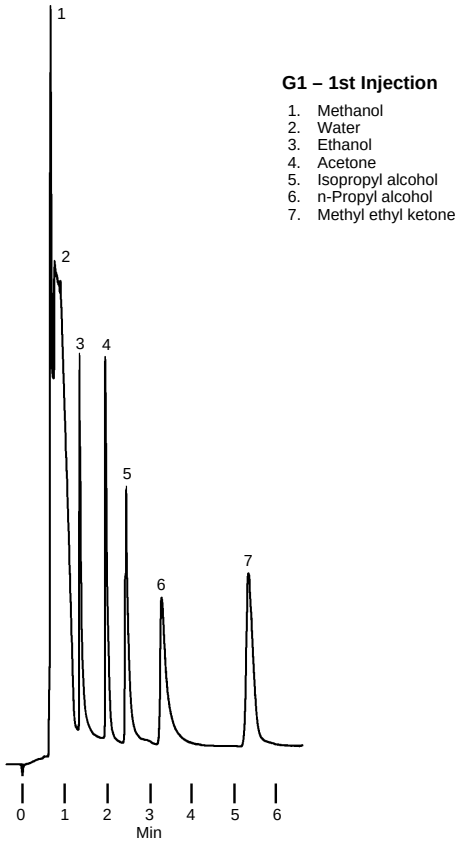
For many analyses, silanized **glass wool plugs** are used to retain the packing in the column. However, our studies have shown that silanized glass wool, especially in the column inlet, may adsorb small amounts of sample components. Such adsorption could be significant in trace analyses. In these analyses, therefore, we recommend omitting glass wool from column inlets. When changing the septum or column, carefully depressurize the system to avoid shifting the packing or blowing it out of the column.

Analysts often attempt to compensate for low concentrations of particular sample components by injecting a **large volume of sample**. The column and detector may be able to accept large samples, but often such samples exceed the volume of the injection port. An excessively large sample produces a sudden pressure increase in the injection port, increasing column flow and causing the flow controller to shut down. As the increased pressure dissipates, the flow controller slowly regains control of the column flow. Retention times, however, have decreased because of the slow response. In addition, gases may have been forced back into the carrier gas feed line, dissipating the sample and possibly causing peaks to tail. Eventually the correct flow is reestablished, but retention times and other analytical parameters for the large sample are not reliable.

To illustrate how sample volume affects retention times, we injected 0-10µL of distilled water with 1µL of an aqueous solution of solvents (0.8% solvents, vol/vol) into a glass column and a

Figure G. Effect of Water Priming on the Water "Peak" from a Carbopack B/3% SP-1500 Column

Packing: **80/120 Carbopack B/3% SP-1500**
Cat. No.: **11813** (packing)
Column: 2m x 2mm ID TightSpec glass
Oven: 100°C
Carrier: nitrogen, 20mL/min
Det.: FID, 250°C
Inj.: 1µL water containing 10ppm each solvent, 200°C



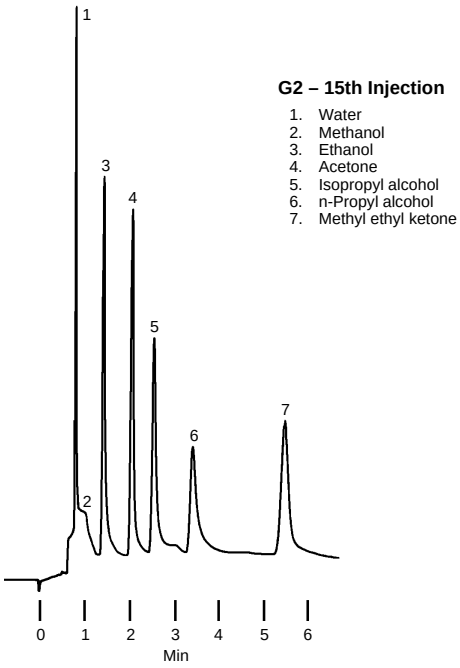


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Table 3. Effect of Sample Size on Retention Times for Solvents in Water

Sample: Distilled Water Volume (µL)	Absolute Retention Time		t_R(pentane)/ t_R(n-propanol)
	n-Propanol	Pentane	
Glass Column (2m x 2mm ID)			
1:0 (before)	6.4	12.5	2.1
1:1	6.5	12.3	2.2
1:2	6.7	12.3	2.1
1:4	6.8	12.1	1.8
1:8	6.8	11.9	1.8
1:10	7.0	11.5	1.6
1:0 (after)	6.3	12.5	2.1
Stainless Steel Column (10' x 1/8" OD)			
1:0 (before)	7.0	13.4	1.9
1:1	7.0	13.2	1.9
1:2	7.0	13.4	1.9
1:4	7.0	13.2	1.9
1:8	7.1	12.9	1.8
1:10	7.25	13.1	1.8
1:0 (after)	7.0	13.5	1.9

stainless steel column, each containing Carbopack B/3% SP-1500. We monitored the retention times for pentane and n-propanol. As progressively more distilled water was injected with the solvent solution, both absolute and relative retention times began shifting (Table 3). The absolute retention data for the glass column shows that the fast eluting n-propanol peak was first to indicate injection port overloading. When a 1:4 mixture was injected, retention times for both compounds were affected. For the stainless steel column, the effect appeared at larger sample volumes. From this data, we concluded that the maximum sample volume for Carbopack B/3% SP-1500 columns should be 2µL (containing 0.9ng to 65µg of each component) for 2m glass columns or 4µL for 10-ft. stainless steel columns.

Contaminants may affect the quantification of sample components. Contamination can occur at several points in the analysis: in glassware used to prepare standards or samples, in the glass injection liner (used in some instruments), or in the syringe used to inject the sample. Good laboratory technique will minimize the possibility of contamination at these sources. All glass surfaces coming in contact with your standards and samples should be as clean as possible. We recommend heating the glassware to remove traces of organics. The GC also should be properly prepared for trace analyses. If your instrument has an injection port liner, we recommend installing a new liner. Most liners are not deactivated by the manufacturer, so be sure to silanize the new liner prior to use. An old liner can be cleaned and baked to remove organics, but still may not provide analyses equal to those obtained with a new liner. Also use a new syringe and reserve it for trace work only, cleaning it carefully between injections. We recommend rinsing the syringe with high purity deionized water, followed by heating and vacuum cleaning in a Hamilton® syringe cleaner.

The proper combination of flow rates for carrier gas, hydrogen, and air are necessary to obtain the high **FID sensitivity** needed to analyze samples for trace components. The specific procedure for fine tuning the FID varies among instrument manufacturers, but in general a good starting mixture is approximately 1:1:10 for carrier gas:hydrogen:air. Good initial ranges are 20-30mL/min for carrier gas and hydrogen, and 200-300mL/min for air.

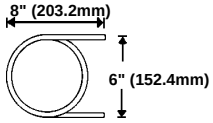
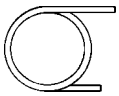
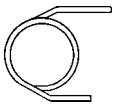
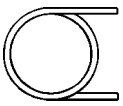
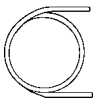
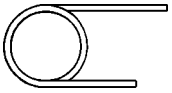
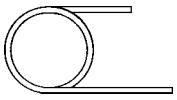
Analysts can use 80/120 Carbopack B/3% SP-1500 columns to monitor many organic compounds as trace components in aqueous solutions. The packing is inert, enabling the user to detect compounds at the maximum sensitivity of an FID. Large amounts of water do not affect packing polarity and stability, and the columns appear to be long lasting. We recommend this packing for the trace work described in this bulletin.

Ordering Information:

Description	Cat. No.
Packing	
80/120 Carbopack B/3% SP-1500, 15g	**11813-U**

Stainless Steel Packed Columns, 10' x 1/8"

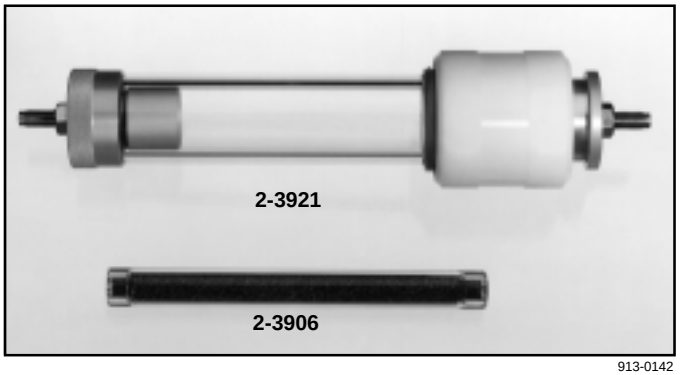
3% SP-1500 on 80/120 Carbopack B

Chromatograph	Model/ Description	Sketch	Cat. No.
General Configuration*			**12592**
Hewlett-Packard	5700, 5992-3 GC-MS		**12593**
	5880, 5890, 5987		**12594**
Perkin-Elmer	900, 3920 Sigma 1,2,3	 (9"/228.6mm Span)	**12595-U**
	8300, 8400, 8500, 8600, 8700, Auto System	 (not on-col. inj.)	**13734**
Varian	3700 Vista Series	 (not on-col. inj.)	**12596**
	3300/3400 Vista Series	 (FID)	**13735-U**
		 (FID)	

713-0427, 0428, 0429, 0430, 0392, 0431, 0418

*You can carefully bend the column to fit most chromatographs.

OMI™ Indicating Purifier



913-0142

- Purifies helium, hydrogen, nitrogen, argon methane
- Color change indicates purifier exhaustion
- Glass body does not diffuse air or off-gas
- Ideal for Hall®, ECD and GC/MS detection systems
- New OMI-4 purifier protects multiple instruments (three times the capacity of OMI-2 tubes)

Irreversibly removes contaminants from carrier gas.

Use this purifier for point-of-use gas polishing and final visual quality assurance before gas enters the GC. Simultaneously removes oxygen, water vapor, carbon monoxide, carbon dioxide, most sulfur compounds, most halogen compounds, alcohols, and phenols to less than 10ppb.

Install the OMI tube downstream from your primary gas purifying device, and tell at a glance whether or not oxygen and moisture are being effectively eliminated from your system. The tube contains Nanochem resin, developed for the demanding gas purity needs of the semiconductor manufacturing industry. As little as 1ppm of oxygen or moisture will change the indicating resin from black to brown.

Spent tubes are easily replaced. Simply unscrew the end assembly from the tube holder and replace your OMI tube. The design prevents air from entering the new tube during installation.

Ordering Information:

Description	Cat. No.
OMI-2 Purifier (tube only)	**23906**
OMI-2 Tube Holder (1/8" fittings; does not include tube)	**23921**
Seal Kit for OMI-2 Tube Holder (Includes 2 Teflon® seals and tool)	**23917**
OMI-4 Purifier (tube only)	**23909**
OMI-4 Tube Holder (1/8" fittings; does not include tube)	**23926**
OMI-1 Replacement Tube* (includes 2 ferrules)	**23900**
3/8" Ferrules, pk. of 10	**22311**
1/4" to 1/8" Swagelok® SS Reducer	**21517**

*Will not fit OMI-2 tube holder. Use with OMI-1 installation kits.

Note: First time users must order both OMI-2 or OMI-4 purifier tube and corresponding holder.

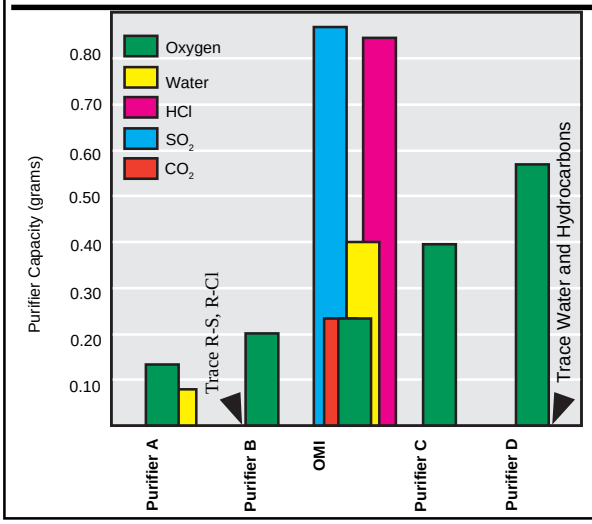
Protect Your Column from Many Carrier Gas Contaminants

Contaminant	OMI Purifier	Indicating Devices	Non-Indicating Oxygen Traps
Oxygen	Yes	Yes **	Yes **
Water	Yes	No	No
Carbon monoxide	Yes	No	No
Carbon dioxide	Yes	No	No
Alcohols/Phenols	Yes	No	No
Sulfur-containing compounds (R-S)	Yes	No	No ***
Halogen-containing compounds (R-Cl)	Yes	No	No ***

**If incoming oxygen level does not exceed 10ppm.

*** Corrosive compounds may poison some of these devices.

OMI Indicating Purifier Removes as Much Oxygen as Most *Nonindicating* Bulk Purifiers



713-0687

Tube Replacement Is Easy.

913-0148

Dimensions of OMI Purifiers

OMI-2		
	Holder	10"L x 2 1/4"OD
	Tube	6"L x 5/8"OD
OMI-4		
	Holder	16"L x 2 1/2"OD
	Tube	12"L x1" OD

For more information about gas purification, request Bulletin 848 (Carrier Gas Purification) and publications 411015 (Nanochem Ensures Gas Purity) and 411016 (Stretch Your Carrier Gas Dollars). OMI purifiers contain Nanochem resin, licensed to Supelco, Inc. for use in chromatographic applications. Nanochem is a registered trademark of Matheson Gas Products.

High Capacity Gas Purifier

994-0140

UL, CSA, and CE listed

No other purifier removes both oxygen and water in such large quantities.

To fully protect your GC columns and detectors from oxygen and moisture damage, you should use a gas purifier specifically designed to ensure maximum gas purity. The Supelco™ High Capacity Gas Purifier tube is heated inside an oven, and oxygen and water react with the gettering material in the tube.* Unlike purifiers which remove contaminants by adsorption, reaction with the gettering material prevents these contaminants from returning to the gas stream — even when the temperature changes or as the material approaches saturation.

A single, replaceable high capacity purifier tube can remove 14L of oxygen or 35L of water vapor (STP). It removes oxygen and water from at least 60 tanks of heavily contaminated gas — gas containing 100ppm of oxygen and/or water. Efficiently removes oxygen and water at gas flow rates up to 1100mL/minute, and you can use it with any *carrier* gas except hydrogen.

The stainless steel converter tube is 10" x 1/2" OD. The split-sided heater is 10" long. The unit's integral mounting bracket allows you to bolt the unit to a bench top or wall. The 90 watt power consumption makes the unit as economical to operate as a light bulb.

Unit has 1-year guarantee; elements guaranteed for 90 days.

Ordering Information:

Description	Cat. No.
High Capacity Gas Purifier (110VAC)	
1/8" fittings	**23800-U**
1/4" fittings	**23802**
High Capacity Gas Purifier (220VAC)	
1/8" fittings	**23801**
1/4" fittings	**23803**
Replacement Purifier Tubes	
1/8" fittings	**22396**
1/4" fittings	**22398**
Replacement Elements	
for 110VAC unit	**24975**
Top element, 220VAC unit	**24976**
Bottom element, 220VAC unit	**24977**

*The High Capacity Gas Purifier also removes carbon monoxide and carbon dioxide.

Supelcarb™ HC Hydrocarbon Traps

996-0219

Remove organics from carrier gases, air, and hydrogen.

Supelcarb HC adsorbent has twice the trapping ability of activated charcoal. Manufactured at Supelco, to ensure the best trapping ability per gram, and the cleanest material available. Available in two sizes, to better meet your needs.

Ordering Information:

Description	Cat. No.
Supelcarb HC Hydrocarbon Traps	
120cc, 1/8" fittings	**24448**
120cc, 1/4" fittings	**24449**
750cc, 1/4" fittings	**24564**
750cc, 1/2" fittings	**24565**
Supelcarb Refill, 300cc	**24566**

Supelpure™-HC Hydrocarbon Traps

Activated charcoal adsorbs hydrocarbons and other contaminants from carrier gases, air, and hydrogen. Operates efficiently for approximately six months when total hydrocarbons in the incoming gas average 10ppm.

Description	Cat. No.
Supelpure-HC Hydrocarbon Traps	
120cc, 1/8" fittings	**22445-U**
120cc, 1/4" fittings	**22446**
750cc, 1/4" fittings	**24518**
750cc, 1/2" fittings	**24519**
Charcoal Refill, 400cc	**22451**
Mounting Clip, 120cc trap	**23993**
Mounting Clip, 750cc trap	**24983**

80/120 Carbopack B/3% SP-1500 was developed in cooperation with Dr. A. DiCorcia of the University of Rome.

Reference

1. Gill, J.M. and C.H. Hartmann, *J. Gas Chromatogr.*, **5:** 605 (1967). Reference not available from Supelco.

Trademarks

Carbopack, OMI, SP, Supelcarb, Supelco, Supelpure, TightSpec – Supelco, Inc.
Cellosolve – Union Carbide Corp.
Freon – E.I. du Pont de Nemours & Co., Inc.
Hall — Tracor Instruments, Austin, Inc.
Hamilton – Hamilton Co.
Swagelok — Crawford Fitting Co.
Teflon — E.I. du Pont de Nemours & Co., Inc.